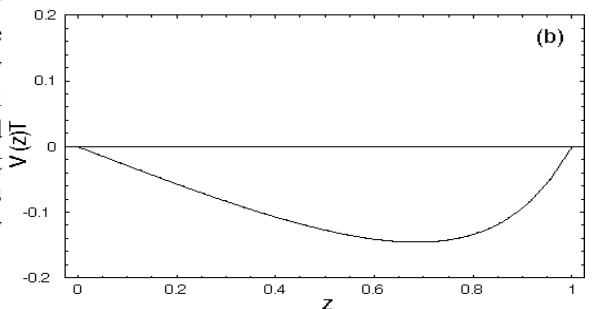
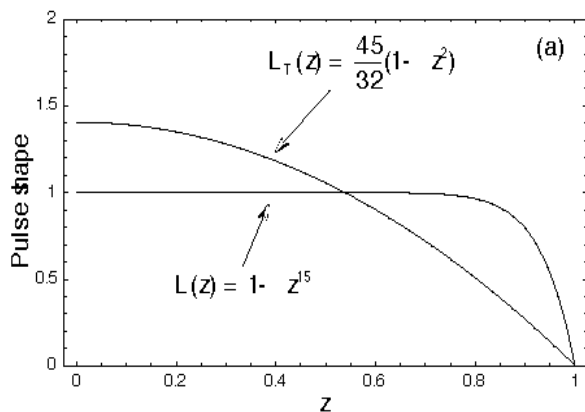


Longitudinal Drift Compression and Pulse Shaping

The objective of drift compression is to compress a long beam bunch by imposing an initial longitudinal-velocity distribution over the length of the beam in the beam frame. The longitudinal dynamics of drift compression and pulse shaping for high-intensity charged-particle beams have been studied using a one-dimensional warm-fluid model. We find that at least two self-similar drift compression solutions exist for the one-dimensional warm-fluid equations: the linear self-similar drift-compression solution, and the parabolic self-similar drift-compression solution. Detailed analysis showed that the latter solution has several desirable features and is a good candidate for practical drift-compression schemes. In the weak space-charge limit, we have asymptotically solved the pulse-shaping problem. That is, we calculate the initial velocity distribution such that a given initial pulse shape gradually evolves into the desired final pulse shape after a certain length of time. Therefore, an arbitrary pulse shape produced after the acceleration phase can be shaped into that required by the self-similar drift compression solutions. In the figure, the initial pulse shape $\Lambda(z) = 1 - z^{15}$ shown in (a) is shaped into the final pulse shape $\Lambda_T(z) = (45/32)(1 - z^2)$ by the initial normalized velocity distribution $V(z)T$ plotted in (b), where T is the pulse shaping time.

— Hong Qin and Ron Davidson

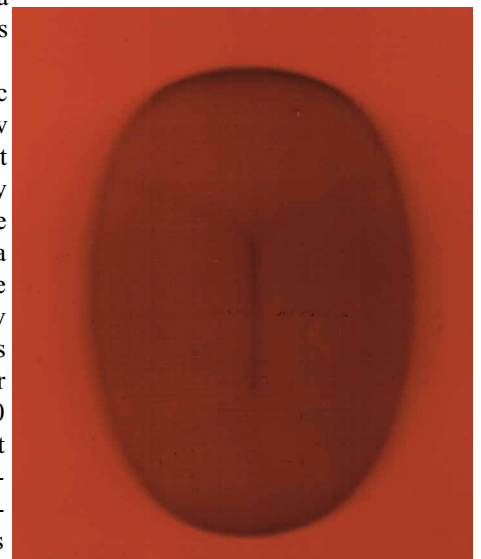


Beam Imaging Diagnostics

Imaging the profile of the beam current density is important to diagnosing heavy ion beams in injector and transport experiments. Recently, we have developed two tools for imaging the beam in the 2-MV Injector, which will become the injector for the High-Current Experiment, HCX.

The first of these tools images the beam on a Kapton film. The beam ions strike the foil and damage the molecular bonds of the Kapton polymer. This damage, which is visibly evident as a darkening of the film, acts as an accurate witness plate of the time-integrated beam current density. Its sensitivity is biased toward heavy particles because of their high momentum, ensuring that the observed image is not significantly perturbed by stray light ions or electrons, and is thus a close reproduction of the beam profile. A picture of a beam image on Kapton is shown in the figure.

To improve diagnostic flexibility, and to allow operation at higher current densities that would destroy Kapton films, we are investigating the use of a glass scintillator to image beam current density profiles. The beam strikes the glass screen after passing through a thin (150 nm) aluminum layer that blocks stray light, low-energy electrons, and low-energy ions. The glass emits visible light as the beam strikes it; capturing the light on a digital camera allows rapid characterization of the beam profile for a variety of beam conditions. Goals for future development include automated downloading of the digital pictures, and time-resolved measurements with a fast camera. — Frank Bieniosek



Safety issues of Hg and Pb as IFE Target Materials

We have analyzed the radiological and toxicological issues of mercury and lead as candidate hohlraum-wall materials. Activation results show that both Hg and Pb are allowable, based on the contact dose rates and waste disposal rating. From the accident analysis perspective, one must distinguish between accidents at the target fabrication facility and at the power plant itself. For an accident at the target fabrication facility, Hg is the most hazardous when estimating doses to the public. However, segregation of the inventory in the plant and optimization of plant layout would make the 1-rem limit goal achievable. On the other hand, in case of accidents involving the power plant primary coolant loop, Pb seems to pose a greater threat due to its higher inventory suspended in the coolant flow of a HYLIFE-II type plant.

From the chemical-safety point of view, both materials have similar values of limit concentration in air for public protection (less than 0.1 mg/m³ of Hg, and less than 0.05 mg/m³ of Pb). However, its high saturation concentration in air at normal temperatures makes Hg a more hazardous option. Somewhat surprisingly, we have determined that the concentrations that would lead to an acceptable radiological dose in case of a gaseous release, would exceed the chemical safety requirements by several orders of magnitude. Consequently, for these two materials, the chemical toxicity is the most critical issue from the safety point of view. — Susana Reyes